Experience with a Technology Transfer Lifecycle and Implementation of Formal Inspections

Linda L. Welz
Manager, Software Product Assurance Resource Center
Member Technical Staff, Advanced Technology Group

John C. Kelly, Ph.D.
Group Supervisor, Advanced Technology Group

Software Product Assurance Section
Jet Propulsion Laboratory
4800 Oak Grove Dr. MS 125-233
Pasadena, CA 91109
Tel: (81 8) -354-6681
FAX: (81 8) -393-1362

lwelz@spa1.jpl.nasa.gov
jkelly@spa1.jpl.nasa.gov

ABSTRACT

In an organization with diverse project support and focus, a technology transfer program will be most successful with support from an advocate who can work to implement new technologies on multiple projects across organizational boundaries. In addition, a strong, on-going technology transfer program needs to be in place to support training, implementation, metrics analysis, and project and organizational feedback for the new technology.

KEYWORDS: software technology transfer, adoption support, organization design, Formal Inspections

1 Position Statement

in an organization where software development is distributed across many groups, a technology transfer program needs a strong, independent advocate providing continuous support along with a fully defined lifecycle for technology implementation to be successful, The technology advocate needs to provide support to management, trainers, and practitioners. The technology transfer lifecycle must include phases for the introduction of the techniques and management acceptance; establishment of training and implementation of a long-term training program; support of pilot project implementation and feedback to management and training based on project results; development of metrics collection and analysis techniques for technology management and process improvement; and establishment of an organizational structure that will continue to support the implementation of the technology.

2 Roles

1. Change Agent - The primary role of our group, the Advanced Technology Group, is to research and transfer advanced methods to projects to improve software quality. To fulfill this mission, services are provided in the areas of advising on existing method, providing training courses; conducting research and analysis into new methods, and tailoring methods to specific project needs.

2. Champion - In support of our role as change agent, our group also acts as the champion of a new technology. Since we are from an assurance organization, our role has been one of an advocate. We interface with projects or organizations who are interested in or have a need for the new technology, presenting the advantages and benefits development organizations would gain from the implementation of a new technique. We work with management, to secure resources to support the new technology, and with developers and product assurance personnel, to adapt the technology to their needs and implement it on their project.

3. Recipient/participant/"target" - A final role that our group may fulfill is that of participant. We may work with a project, participating as a project member, when a technique is first introduced. In this role we are able to provide a project with expertise in the technology being introduced, while gaining actual project experience that can be fed back to improve the technology transfer for new projects.

3 Discussion

Over the last five years, we have been implementing a program to transfer Formal Inspections to software pejects first at the Jet Propulsion Laboratory and then at other NASA centers (Langley Research Center, Ames Research Center, Johnson Space Center, Lewis Research Center). Formal Inspections (Fagan Inspections tailored for JPL and NASA) are a set of technical reviews whose objective is to increase quality and reduce the cost of software development by detecting and correcting errors early.

JPL has a matrix organization with software development efforts originating in many line organizations, each working independently on non-related projects. The implementation of any new technology would therefore be on a project by project basis. To reach this widely distributed audience, the first step for transferring this technique was to develop training courses to educate software developers and managers from many projects about ormal Inspections. Students would then take the concept back to their project for implementation. However, without management support, the technology was not being implemented. Therefore, in parallel with the training, project management was solicited to participate in pilot studies to implement Formal Inspections. Both these efforts required constant advocacy from the Advanced Technology Group in maintaining the training and in initiating the pilot studies.

Results from the pilot studies were analyzed and used to improve the Formal Inspection Technology Transfer program in several ways. First, the course materials were updated to reflect the specific training requirements of JPL projects. Secondly, experience from the pilot studies enabled the Advanced Technology Group to improve its ability to assist in tailoring Formal Inspections for project needs. Finally, results from JF'L projects were used in gaining management sponsorship on new projects. The data provided a persuasive argument to management of the cost effectiveness of finding and fixing defects early in the lifecycle.

Even with obvious success from Formal Inspections on several projects (Kelly, Sherif, and Hops (1992), and Sherif and Kelly (1992)), the technology did not propagate across diverse JPL projects independently despite the fact that some of the developers on new projects had experience with inspections on previous projects. Constant support and advocacy were required. The training courses continued to be a good vehicle for spreading the word about Formal Inspections. As more data from inspections became available, a Formal Inspection database was established which enabled the Advanced Technology Group to provide data analysis and reporting support to projects, and to show how JPL was benefiting as an institution from Formal Inspections. Discussions were held with management of projects to inform them of the Formal Inspection process and to persuade them to implement it on their projects.

Based on the success of the Formal Inspection program at JPL, NASA Headquarters sponsored a work effort to establish similar programs at other centers. This Formal Inspection Transfer Program provides support for 1) awareness activities and training materials, 2) data base development for inspection metrics, 3) local inspection program planning, 4) tailoring inspections for local needs, 5) consultation for a center advocate and trainers. Each of the NASA centers adopting a Formal Inspection program has the same requirements as JPL for technology transfer of Formal Inspections - a center advocate and an established on-going support structure for the program.

4 Significance

In an organization with diverse project support and focus, a technology transfer program will be most successful with support from an advocate who can work to implement new technologies on multiple projects across organizational boundaries. In addition, a strong, on-going technology transfer program needs to be in place to support training, implementation, metrics analysis, and project and organizational feedback for the new technology. This type of long term technology transfer group can support on-going efforts in addition to bringing in new technologies, thus providing a larger organization with resources and expertise to support software development.

5 Biography

Linda L. Welz is the Manager of the Software Product Assurance Resource Center and a member of the Advanced Technology Group of the Software Product Assurance Section at the Jet Propulsion Laboratory. Linda works with other member of the group to apply the Technolog/ Transfer lifecycle to several software techniques including Formal Inspections, Object Oriented Software Development, and Formal Methods, She also teaches Formal Inspection Training courses and works directly with software development projects to implement Formal Inspections. Linda is also involved in a research project, focusing on the use of human-computer interfaces for systems development in space flight mission operations and supports mission operations and command assurance activities at JPL. Prior to working on these tasks, Linda was Mission Operations and Command Assurance Manager for the Magellan project and a Software Product Assurance Engineer at JPL. Before coming to JPL, Linda worked in the Administrative Computing Group at the University of California Berkeley, and at the Western Region Exploration Group of Chevron Geosciences. Linda has been working in the software field for over fourteen years.

John Kelly, Ph. D., is the supervisor of the Advanced Technology Group in Software Product Assurance at the Jet Propulsion Laboratory. He played a significant role in introducing Software Inspections at JPL. He developed the initial versions of course materials for software inspections which have been used to teach over 1000 staff members at JPL and other NASA centers. He was also JPL's first Chief Moderator for inspections, which included the monitoring and controlling of this process through a metrics program. The Software Inspection Program received a JPL Team Excellence award for Quality and Productivity in October 1990. Prior to joining JPL, Dr. Kelly was a professor of Computer Science at Furman University in Greenville, S.C. Currently he is revolved in technology transfer pilot studies and courseware development in the areas of Object Oriented Software Development and Formal Methods.

6 References

Kelly, John C.; Joseph S. Sherif, and Jonathan Hps. 1992. An Analysis of Defect Densities Found During Software Inspections. J.Systems Software. 17:111-117.

Sherif, Yosef S., and John C. Kelly. 1992. Improving Software Quality Through Formal Inspections. Microelectron.Reliab. 32(3): 423-431.